

CLAIM AMENDMENTS

Claims 1 to 87 (cancelled)

1 88. (Original) A three-dimensional optical memory
2 comprising fluorescent photosensitive glass, wherein said glass
3 comprises at least one of two or more rare earths selected from the
4 group consisting of ytterbium (Yb), samarium (Sm), and combinations
5 thereof; and at least one of two or more rare earths selected from
6 a group consisting of erbium (Er), holmium (Ho), samarium (Sm),
7 dysprosium (Dy), Terbium (Tb), neodymium (Nd) and combinations
8 thereof.

1 89. (Original) A three-dimensional optical memory of
2 fluorescent photosensitive glass according to claim 88 wherein said
3 glass further comprises about 10 mole percent to about 80 mole
4 percent SiO_2 , up to about 54 mole percent K_2O , up to about 58 mole
5 percent Na_2 , up to about 35 mole percent Li_2O , up to about 40 mole
6 percent BaO , up to about 40 mole percent SrO , up to about 56 mole
7 percent CaO , up to about 42 mole percent MgO , up to about 48 mole
8 percent ZnO and up to about 5 mole percent of said two or more rare
9 earths in oxide form.

1 90. (Original) A three-dimensional optical memory of
2 fluorescent photosensitive glass according to claim 88 wherein said
3 glass further comprises about 20 mole percent to about 80 mole
4 percent P_2O_5 , up to about 47 mole percent K_2O , up to about 60 mole
5 percent Na_2O , up to about 60 mole percent Li_2O , up to about 58 mole
6 percent BaO , up to about 56 mole percent SrO , up to about 56 mole
7 percent CaO , up to about 60 mole percent MgO , up to about 64 mole
8 percent ZnO , up to about 5 mole percent yttrium (Y) ytterbium, and
9 up to about 5 mole percent of said two or more rare earths in oxide
10 form.

1 91. (Original) A three-dimensional optical memory
2 comprising fluorescent photosensitive vitroceraamic, wherein said
3 vitroceraamic comprises one or more photosensitizing metals and one
4 or more rare earths, one or more photosensitizing metals is se-
5 lected from the group consisting of gold (Au), copper (Cu) and
6 combinations thereof; and one or more rare earths is selected from
7 the group consisting praseodymium (Pr), dysprosium (Dy), erbium
8 (Er), holmium (Ho), europium (Eu), thulium (Tm) and combinations
9 thereof.

1 92. (Original) The three-dimensional optical memory of
2 fluorescent photosensitive vitroceramic according to claim 91
3 wherein said vitroceramic further comprises, in mole percent, about
4 10% to about 60% SiO₂, about 5% to about 60% PbF₂, about 0.05% to
5 about 0.3% Sb₂O₃, up to about 0.5% CeO₂, up to about 60% CdF₂, up to
6 about 30% GeO₂, up to about 10% TiO₂, up to about 10% ZrO₂, up to
7 about 40% Al₂O₃, up to about 40% Ga₂O₃, and about 10% to about 30%
8 LnF₃ where Ln1 is selected from the group consisting of yttrium
9 (Y) and ytterbium (Yb).

1 93. (Original) The three-dimensional optical memory of
2 fluorescent photosensitive vitroceramic according to claim 92
3 wherein said Ln1 comprises ytterbium (Yb) and said Ln2 is selected
4 from the group consisting of Er, Ho, Tm and combinations thereof;
5 whereby said vitroceramic is capable of converting incident infra-
6 red radiation into visible light.

1 94. (Original) The three-dimensional optical memory of
2 fluorescent photosensitive vitroc ceramic according to claim 93
3 wherein said Ln1 comprises yttrium (Y) and said Ln2 is selected
4 from the group consisting of Pr, Dy, Ho, Er, Eu, Tm and combina-
5 tions thereof; whereby said vitroc ceramic is capable of converting
6 incident ultraviolet light into visible light.

1 95. (New) A data storage and retrieval system for
2 storing information on, and retrieving information from, a three-
3 dimensional fluorescent photosensitive optical memory, said system
4 comprising:

5 (a) a first coherent light beam generator in the form of
6 a first Ti:sapphire laser for generating a first coherent light
7 beam;

8 (b) a second coherent light beam generator in the form of
9 a second Ti:sapphire laser for generating a second coherent light
10 beam; and

11 c) an optical positioning system for directing said first
12 coherent light beam and said second coherent light beam to irradi-
13 ate an individually selected volume of said optical memory to
14 produce a change in fluorescence characteristics in said selected
15 volume.

1 96. (New) A data storage and retrieval system for
2 storing information on, and retrieving information from, a three-
3 dimensional fluorescent photosensitive optical memory, said system
4 comprising:

5 (a) a first coherent light beam generator for generating
6 a first coherent light beam;

7 (b) a second coherent light beam generator for generating
8 a second coherent light beam; and

9 c) an optical positioning system for directing said first
10 coherent light beam and said second coherent light beam to irradi-
11 ate an individually selected volume of said optical memory to
12 produce a change in fluorescence characteristics in said selected
13 volume; and

14 (d) an optical focusing system comprising a confocal
15 microscope for focusing said first coherent light beam and said
16 second coherent light beam on said optical memory.

1 97. (New) A data storage and retrieval system for
2 storing information on, and retrieving information from, a
3 three-dimensional fluorescent photosensitive optical memory, said
4 system comprising:

5 (a) a coherent light beam generator for generating a
6 coherent light beam; and

7 (b) an optical positioning system for directing said
8 coherent light beam to irradiate an individually selected volume of

9 said optical memory to produce a change in fluorescence character-
10 istics in said selected volume.

1 98. (New) The data storage and retrieval system
2 according to claim 97 wherein said coherent light beam generator
3 irradiates said individually selected volume of said optical memory
4 with said coherent light beam at a predetermined writing wavelength
5 to cause a change in fluorescence characteristics in said selected
6 volume.

1 99. (New) The data storage and retrieval system accord-
2 ing to claim 97 further comprising an optical focusing system for
3 focusing said coherent light beam on said optical memory.

1 100. (New) The data storage and retrieval system
2 according to claim 99 wherein said optical focusing system com-
3 prises a confocal microscope.

1 101. (New) The data storage and retrieval system
2 according to claim 97 wherein said optical positioning system
3 further comprises a vertical scanning system to position said
4 coherent light beam along a vertical axis of said optical memory.

1 102. (New) The data storage and retrieval system
2 according to claim 97 wherein said optical positioning system
3 further comprises a radial scanning system to position said coher-
4 ent light beam along a radial axis of said optical memory.

1 103. (New) The data storage and retrieval system
2 according to claim 97 wherein said optical positioning system
3 further comprises a motor to rotate said optical memory.

1 104. (New) The data storage and retrieval system
2 according to claim 97 wherein said coherent light beam generator is
3 a laser.

1 105. (New) The data storage and retrieval system
2 according to claim 104 wherein said laser is a Ti: sapphire laser.

1 106. (New) The data storage and retrieval system
2 according to claim 104 wherein said laser is a pulse laser.

1 107. (New) The data storage and retrieval system
2 according to claim 97 further comprising a reading system for
3 reading information from said optical memory, said reading system
4 comprising:

5 (a) a reading light beam generator for generating a
6 reading light beam to excite at least an individually selected
7 volume of said optical memory with said reading light beam at a
8 predetermined reading wavelength; and

9 (b) a detector for detecting fluorescence in at least
10 said individually selected volume.

1 108. (New) The data storage and retrieval system
2 according to claim 107 wherein said reading light beam generator
3 excites a volumetric slice of said optical memory with said reading
4 light beam, said volumetric slice including multiple individual
5 volumes.

1 109. (New) The data storage and retrieval system
2 according to claim 107 wherein said reading light beam generator is
3 a coherent light beam generator.

1 110. (New) The data storage and retrieval system
2 according to claim 109 wherein said coherent light beam generator
3 is a laser.

1 111. (New) The data storage and retrieval system
2 according to claim 109 wherein said laser is a
3 Ti: sapphire laser.

1 112. (New) The data storage and retrieval system
2 according to claim 109 wherein said laser is a pulse laser.

1 113. The data storage and retrieval system according to
2 claim 107 further comprising an optical focusing system for focus-
3 ing said coherent reading light beam on at least individually
4 selected volume of said optical memory.

1 114. The data storage and retrieval system according to
2 claim 113 wherein said optical focusing system comprises a confocal
3 microscope.

1 115. The data storage and retrieval system according to
2 claim 107 further comprising a vertical scanning system to position
3 said reading light beam along a vertical axis of said optical
4 memory.

1 116. The data storage and retrieval system according to
2 claim 107 further comprising a radial scanning system to position
3 said reading light beam along a radial axis of said optical memory.

1 117. The data storage and retrieval system according to
2 claim 107 further comprising a radial scanning system to position
3 said detector along a radial axis of said optical memory.

1 118. The data storage and retrieval system according to
2 claim 107 further comprising a motor to rotate said optical memory.

1 119. The data storage and retrieval system according to
2 claim 97 wherein said fluorescent photosensitive optical memory
3 comprises glass, said glass comprises two or more rare
4 earths, at least one of said two or more rare earths is selected
5 from the group consisting of europium (Eu), ytterbium (Yb),
6 samarium (Sm), and combinations thereof; and at least one of said
7 two or more rare earths is selected from a group consisting of
8 erbium (Er), thulium (Tm), ytterbium (Yb), holmium (Ho), samarium
9 (Sm), dysprosium (Dy), terbium (Tb), neodymium (Nd) and combina-
10 tions thereof.

1 120. (New) The data storage and retrieval system
2 according to claim 119 wherein said glass further comprises about
3 10 mole percent to about 80 mole percent SiO_2 , up to about 54 mole
4 percent K_2O , up to about 58 mole percent Na_2O , up to about 35 mole
5 percent Li_2O , up to about 40 mole percent BaO , up to about 40 mole
6 percent SrO , up to about 56 mole percent CaO , up to about 42 mole
7 percent MgO , up to about 48 mole percent ZnO and up to about 5 mole
8 percent of said two or more rare earths in oxide form.

1 121. (New) The data storage and retrieval system
2 according to claim 119 wherein said glass further comprises about
3 20 mole percent to about 80 mole percent P_2O_3 , up to about 47 mole
4 percent K_2O , up to about 60 mole percent Na_2O , up to about 60 mole
5 percent Li_2O , up to about 58 mole percent BaO , up to about 56 mole
6 percent SrO , up to about 56 mole percent CaO , up to about 60 mole
7 percent MgO , up to about 64 mole percent ZnO , up to about 5 mole
8 percent yttrium (Y), and up to about 5 mole percent of said two or
9 more rare earths in oxide form.

1 122. (New) The data storage and retrieval system
2 according to claim 97 wherein said fluorescent photosensitive
3 memory comprises vitroc ceramic, said vitroc ceramic comprises one or
4 more photosensitizing metals selected from the group consisting of
5 silver (Ag), gold (Au), copper (Cu) and combinations thereof; and
6 one or more rare earths selected from the group consisting of
7 praseodymium (Pr), dysprosium (Dy), erbium (Er), holmium (Ho),
8 europium (Eu), thulium (Tm) and combinations thereof.

1 123. (New) The data storage and retrieval system
2 according to claim 122, wherein said vitroc ceramic further com-
3 prises, in mole percent, about 10% to about 60% SiO_2 , about 5% to
4 about 60% PbF_2 , about 0.05% to about 0.3% Sb_2O_3 , up to about 0.5%
5 CeO_2 , up to about 60% CdF_2 , up to about 30% GeO_2 , up to about 10%

6 TiO₂, up to about 10% ZrO₂, up to about 40% Al₂O₃, up to about 40%
7 Ga₂O₃, and about 10% to about 30% LnF₃ where Ln1 is selected from
8 the group consisting of yttrium (Y) and ytterbium (Yb).

1 124. (New) The data storage and retrieval system accord-
2 ing to claim 123, wherein said Ln1 comprises ytterbium (Yb) and
3 said Ln2 is selected from the group consisting of Er, Ho, Tm and
4 combinations thereof; whereby said vitroceramic is capable of
5 converting incident infrared radiation into visible light.

1 125. (New) The data storage and retrieval system
2 according to claim 124, wherein said Ln1 comprises yttrium (Y) and
3 said Ln2 is selected from the group consisting of Pr, Dy, Ho, Er,
4 Eu, Tm and combinations thereof; whereby said vitroceramic is
5 capable of converting incident ultraviolet light into visible
6 light.

1 126. (New) A data retrieval system for reading informa-
2 tion from a three-dimensional fluorescent photosensitive optical
3 memory, said retrieval system comprising:

4 (a) a reading light beam generator for generating a
5 reading light beam to excite at least an individually selected
6 volume of said optical memory with said reading light beam at a
7 predetermined reading wavelength; and

8 (b) a detector for detecting fluorescence in at least
9 said individually selected volume.

1 127. (New) The data retrieval system according to
2 claim 126 wherein said reading light beam generator is a coherent
3 light beam generator.

1 128. (New) The data retrieval system according to
2 claim 127 wherein said coherent light beam generator is a laser.

1 129. (New) The data retrieval system according to claim
2 128 wherein said laser is a Ti: sapphire laser.

1 130. (New) The data retrieval system according to
2 claim 128 wherein said laser is a pulse laser.

1 131. (New) The data retrieval system according to claim
2 129 further comprising an optical focusing system for focusing said
3 reading light beam on said individually selected volume of said
4 optical memory.

1 132. (New) The data retrieval system according to claim
2 131 wherein said optical focusing system comprises a confocal
3 microscope.

1 133. (New) The data retrieval system according to claim
2 126 further comprising a vertical scanning system to position said
3 reading light beam along a vertical axis of said optical memory.

1 134. (New) The data retrieval system according to claim
2 126, further comprising a radial scanning system to position said
3 reading light beam along a radial axis of said optical memory.

1 135. (New) The data retrieval system according to claim
2 126 wherein said fluorescent photosensitive memory comprises glass,
3 said glass comprises two or more rare earths, at least one of said
4 two or more rare earths is selected from the group consisting of
5 europium (Eu), ytterbium (Yb), samarium (Sm), and combinations
6 thereof; and at least one of said two or more rare earths is
7 selected from a group consisting of erbium (Er), thulium (Tm),
8 ytterbium (Yb), holmium (Ho), samarium (Sm), dysprosium (Dy),
9 terbium (Tb), neodymium (Nd) and combinations thereof.

1 136. (New) The data retrieval system according to claim
2 135 wherein said glass further comprises about 10 mole percent to
3 about 80 mole percent SiO_2 , up to about 54 mole percent K_2O , up to
4 about 58 mole percent Na_2O , up to about 35 mole percent Li_2O , up to
5 about 40 mole percent BaO , up to about 40 mole percent SrO , up to
6 about 56 mole percent CaO , up to about 42 mole percent MgO , up to
7 about 48 mole percent ZnO and up to about 5 mole percent of said
8 two or more rare earths in oxide form.

1 137. (New) The data retrieval system according to claim
2 135, wherein said glass further comprises about 20 mole percent to
3 about 80 mole percent 45 up to about 47 mole percent K_2O , up to
4 about 60 mole percent Na_2O , up to about 60 mole percent Li_2O , up to
5 about 58 mole percent BaO , up to about 56 mole percent SrO , up to
6 about 56 mole percent CaO , up to about 60 mole percent MgO , up to
7 about 64 mole percent ZnO , up to about 5 mole percent yttrium (Y),
8 and up to about 5 mole percent of said two or more rare earths in
9 oxide form.

1 138. The data retrieval system according to claim 126,
2 wherein said fluorescent photosensitive memory comprises vitro-
3 ceramic, said vitroc ceramic comprises one or more
4 photosensitizing metals selected from the group consisting of
5 silver (Ag), gold (Au), copper (Cu) and combinations thereof ; and
6 one or more rare earths selected from the group consisting of
7 praseodymium (Pr), dysprosium (Dy), erbium (Er), holmium (Ho),
8 europium (Eu), thulium (Tm) and combinations thereof.

1 139. (New) The data retrieval system according to
2 claim 138, wherein said vitroc ceramic further comprises, in mole
3 percent, about 10% to about 60% SiO_2 , about 5% to about 60% PbF_2 ,
4 about 0.05% to about 0.3% Sb_2O_3 , up to about 0.5% CeO_2 , up to about
5 60% CdF_2 , up to about 30% GeO_2 , up to about 10% TiO_2 , up to about
6 10% ZrO_2 , up to about 40% Al_2O_3 , up to about 40% Ga_2O_3 , and about 10%
7 to about 30% LnF_3 where Ln1 is selected from the group consisting
8 of yttrium (Y) and ytterbium (Yb).

1 140. (New) The data retrieval system according to
2 claim 139, wherein said Ln1 comprises ytterbium (Yb) and said Ln2
3 is selected from the group consisting of Er, Ho, Tm and combina-
4 tions thereof, whereby said vitroc ceramic is capable of converting
5 incident infrared radiation into visible light.

1 141 (New) The data retrieval system according to claim
2 139, wherein said Ln1 comprises yttrium (Y) and said Ln2 is se-
3 lected from the group consisting of Pr, Dy, Ho, Er, Eu, Tm and
4 combinations thereof; whereby said vitroc ceramic is capable of
5 converting incident ultraviolet light into visible light.

1 142. (New) A method for retrieving data from a fluo-
2 rescent photosensitive three-dimensional optical memory, said
3 method comprising:

4 (a) generating a reading light beam;

5 (b) exciting at least an individually selected volume of
6 said optical memory with said reading light beam at a predetermined
7 reading wavelength; and

8 c) detecting fluorescence in at least said individually
9 selected volume.

1 143. (New) The method for retrieving data according to
2 claim 142 further comprising generating said reading light beam
3 from a coherent light beam generator.

1 144. (New) The method for retrieving data according to
2 claim 142 comprising generating said reading light beam from a
3 laser.

1 145. (New) The method for retrieving data according to
2 claim 144 comprising generating said reading light beam from a Ti:
3 sapphire laser.

1 146. (New) The method for retrieving data according to
2 claim 144 comprising generating said reading light beam from a
3 pulse laser.

1 147. (New) The method for retrieving data according to
2 claim 142 comprising detecting fluorescence in at least said
3 individually selected volume using a detector.

1 148. (New) The method for retrieving data according to
2 claim 142 further comprising focusing said reading light beam on
3 said optical memory.

4 149. (New) The method for retrieving data according to
5 claim 148 wherein said focusing further comprises using a confocal
6 microscope.

1 150. (New) The method for retrieving data according to
2 claim 142 further comprising position said reading light beam along
3 a vertical axis of said optical memory using a vertical scanning
4 system.

5 151. (New) The method for retrieving data according to
6 claims 142 further comprising positioning said reading light beam
7 along a radial axis of said optical memory using a radial scanning
8 system.

1 152. (New) The method for retrieving data according to
2 claim 142, comprising providing a fluorescent photosensitive
3 memory comprising glass, said glass comprising using two or more
4 rare earths, selecting at least one of said two or more rare earths
5 from the group consisting of europium (Eu), ytterbium (Yb), samar-
6 ium (Sm), and combinations thereof, and selecting at least one of
7 said two or more rare earths from a group consisting of erbium
8 (Er), thulium (Tm) ytterbium (Yb), holmium (Ho), samarium (Sm),
9 dysprosium (Dy), terbium (Tb), neodymium (Nd) and combinations
10 thereof.

1 153. (New) The method for retrieving data according to
2 claim 152, comprising using glass further comprising about 10 mole
3 percent to about 80 mole percent SiO_2 , up to about 54 mole percent
4 K_2O , up to about 58 mole percent Na_2O , up to about 35 mole percent
5 Li_2O , up to about 40 mole percent BaO , up to about 40 mole percent
6 SrO , up to about 56 mole percent CaO , up to about 42 mole percent
7 MgO , up to about 48 mole percent ZnO and up to about 5 mole percent
8 of said two or more rare earths in oxide form.

1 154. (New) The method for retrieving data according to
2 claim 152 comprising using glass further comprising about 20 mole
3 percent to about 80 mole percent P_2O_5 , up to about 47 mole percent
4 K_2O , up to about 60 mole percent Na_2O , up to about 60 mole percent
5 Li_2O , up to about 58 mole percent BaO , up to about 56 mole percent
6 SrO , up to about 56 mole percent CaO , up to about 60 mole percent
7 MgO , up to about 64 mole percent ZnO , up to about 5 mole percent
8 yttrium (Y), and up to about 5 mole percent of said two or more
9 rare earths in oxide form.

1 155. (New) The method for retrieving data according to
2 claim 142, providing a fluorescent photosensitive memory comprising
3 vitroc ceramic, said vitroc ceramic comprising using one or more
4 photosensitizing metals and one or more rare earths, selecting one
5 or more said photosensitizing metals from the group consisting of

6 silver (Ag), gold (Au), copper (Cu) and combinations thereof; and
7 selecting one or more said rare earths from the group consisting of
8 praseodymium (Pr), dysprosium (Dy), erbium (Er), holmium (Ho),
9 europium (Eu), thulium (Tm) and combinations thereof.

1 156. (New) The method for retrieving data according to
2 claim 155, comprising using said vitroceramic further comprising,
3 in mole percent, about 10% to about 60% SiO_2 , about 5% to about 60%
4 PbF_2 , about 0.05% to about 0.3% Sb_2O_3 , up to about 0.5% CeO_2 , up to
5 about 60% CdF_2 , up to about 30% GeO_2 , up to about 10% TiO_2 , up to
6 about 10% ZrO_2 , up to about 40% Al_2O_3 , up to about 40% Ga_2O_3 , and
7 about 10% to about 30% LnIF_3 where Ln1 is selected from the group
8 consisting of yttrium (Y) and ytterbium (Yb).

1 157. (New) The method for retrieving data according to
2 claim 156, comprising using vitroceramic wherein said Ln1 comprises
3 ytterbium (Yb) and said Ln2 is selected from the group consisting
4 of Er, Ho, Tm and combinations thereof, whereby said vitroceramic
5 is capable of converting incident infrared radiation into visible
6 light.

1 158. The method for retrieving data according to claim
2 152, comprising using vitroceramic wherein said Ln1 comprises
3 yttrium (Y) and said Ln2 is selected from the group consisting of
4 Pr, Dy, Ho, Er, Eu, Tm and combinations thereof; whereby said
5 vitroceramic is capable of converting incident ultraviolet light
6 into visible light.